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TABLE OF CONTENTS

ABSTRACTS OF PAPERS PRESENTED AT FIRST ANNUAL MEETING.

FORTHCOMING CONFERENCES AND SEMINARS - 1977-1978.

LIST OF C.L.R.A. OFFICERS, 1976-1977.

MINUTES OF FIRST ANNUAL MEETING.

C.L.R.A. MEMBERSHIP LIST, BY COUNTRY.

AYERST, M. The Effect of Compaction of Coal Shale on the Revegetation of Spoil Heaps. Crewe and Alsager College, Alsager, Cheshire, Great Britain.

The traditional method of tipping coal shale in Britain has produced tips that contain air voids between shale particles as a result of coming to rest under gravity. This may lead to dual problems of combustion and instability.

Since 1966 the National Coal Board of Great Britain has introduced codes of practice that require the colliery management to compact the shale in thin layers, building a tip that contains the minimum air. In addition, natural weathering of shale and mudstone material produces clay that blocks the pores between the shale particles. On drying this can produce a hard crust on the surface that is impenetrable to plant roots.

As a result germinating seeds will not survive unless the surface of the shale is first scarified to a depth of several inches. This alleviation of compaction is only temporary as rainfall tends to recompact the surface of the shale. The layer with a high soil density below the scarified layer acts in the same way as a hard pan preventing the penetration of roots to any great depth. This results in the plant cover being susceptible to drought.

ABBOTT, D., G.B. BACON. Reclamation of Coal Mine Wastes in New Brunswick. Research & Productivity Council, Box 6000, Fredericton, New Brunswick.

Approximately 11,000 acres have been disturbed near Minto in the last 40 years. The wastes are shale with minor quantities of sandstone. The soil and subsoil layer is 1 to 3 ft. thick. The shales weather within a year or two to a gravelly meterial (pH 4-5) while the sandstones are more resistant and also form a more acid debris (pH 4). The major growth-limiting factors are not physical but are the high acidity and low pH of the wastes.

Over the period 1967-74, 3.8 million trees were planted on 4,000 acres of spoil heap without prior preparation. The most successful species are red, scot and jack pine and black locust. Ground cover was planted on graded spoil heaps near major highways. The successful legumes and grasses were white dutch and sweet clover, birdsfoot trefoil and red top. Ponds were stocked with brook trout.

A comprehensive land reclamation scheme is being drawn up which will come into effect in 1979 when increased coal production will mean that stripping will be at the rate of about 400 acres per year. In order to return the land to a productive state as soon as possible, the acid wastes will be buried and any acid drainage controlled. The spoil heaps will be graded and most of the land afforestated. Some pasture land will be cultivated and the ponds will be stocked with fish. Multi-purpose land use will be developed for the forest industry, the preservation of wildlife and for recreational purposes.

DZATKO, J.P., STEPHEN, G.L. Pipeline Right-of-Way Maintenance.
TransCanada Pipelines Limited, Toronto, Ontario.

Introduction: TransCanada Pipeline Limited is a natural gas transmission company which purchases gas from Alberta and Saskatchewan and transports and sells it to customers at delivery points in Saskatchewan, Manitoba, Ontario and Quebec and at several locations on the international border to customers serving U.S. markets. The natural gas pipeline system starts at the Alberta/Saskatchewan border and extends east across Canada to the Quebec/Vermont border. This pipeline system is situated in a right-of-way which totals over 2,647 miles in length with the width of the right-of-way varying from 155' to 60' and in some cases 35' wide, depending upon the number of pipelines in the area and the geographic location. As is evident, the right-of-way is very extensive, passing through changing areas with differing terrains, soils and climates. This leads to a variety of right-of-way maintenance problems which require a variety of approaches to find suitable solutions. The purpose of the presentation is to indicate how the pipeline right-of-way is maintained to ensure that the pipeline is operated in a safe and efficient manner.

Regulations and Code Requirements: TransCanada Pipeline is regulated by the National Energy Board Act, Gas Pipeline Regulations and the Canadian Standards Association, Standard Z184, Gas Pipeline Systems.

Implementation of Regulations and Code Requirements: To ensure the safe and efficient operation of its pipeline system and comply with these requirements, the Company has implemented the following programs for pipeline right-of-way maintenance.

Patrol of Pipeline System: The Company's aviation department uses its 2 helicopters and 3 fixed winged aircraft to carry out an aerial patrol of the whole system at least once per week. This provides a method of early detection of soil erosion and other faults so that repair procedures can be implemented. In addition, the pipeline right-of-way is physically walked once a year and ground leak detection surveys are also carried our in which right-of-way problems are reported for necessary action.

Right-Of-Way Maintenance Programs: All soil erosion problems on the pipeline right-of-way are placed into three categories for remedial treatment.

(a) Minor Right-Of-Way Maintenance: This category is used to describe minor soil erosion problems such as finger washes, sink holes and small areas sparsely vegetated. This work is handled by the local maintenance crews which possess limited equipment. General seeding guidelines are provided to assist in establishing a cover crop.

(b) Major Right-Of-Way Maintenance: This category contains more serious erosion problems which require some engineering design, are larger in scope, and require specialized equipment and cover crop techniques. This work is contracted out to a specialized erosion control contractor who is responsible for the engineering design and implementation of the repair.

(c) Individual Soil Erosion Problems: A serious soil erosion problem is handled on an individual basis. An example of work in this category would be a serious land slide of a river bank. A project in this category requires substantial engineering design and special techniques and materials, such

as retaining walls, drainage piping, filter materials and rip rap to effect a permanent repair. All engineering design is carried out by TransCanada PipeLines and civil contracting firms and specialist cover crop contractors utilized to carry out the work.

Conclusions: This presentation is a brief outline of how TransCanada PipeLines conduct maintenance on its pipeline right-of-way. Keeping up to date with the latest products and techniques in soil erosion control and land reclamation assists TransCanada to maintain its right-of-way and to enhance the safety and efficiency of its pipeline operation with the least amount of dislocation to the environment.

GILLESPIE, E. A Review of Cover Crops as a Biological Control for Weeds and Woody Growth Incompatible with Overhead Electrical Conductors.
Ontario Hydro, 700 University Avenue, Toronto, Ontario.

There is a difference of opinion among experts as to whether shrubs or grasses are the better right-of-way around cover for aesthetic, wildlife, ecological and maintenance points of view.

Ontario Hydro's policies and practices attempt to take the best of both options, by establishing grasses on all new rights-of-way and on some existing ones and by encouraging the growth of shrubs and trees compatible with the overhead conductors.

Experimental work has shown that common farm grasses and legumes establish without fertilization or cultivation especially on newly cut or recently sprayed rights-of-way

The main species used are Champ Timothy, Reed Canarygrass and Smooth Bromegrass. Only species that are compatible with the crops grown by adjacent owners are sown.

Winter seeding on the snow has been found to be the most successful time of seeding.

As well as the prime objective of reducing herbicide spraying cost, cover crops reduce soil erosion to acceptable levels, especially after construction and the placing of counterpoise, and enhance the right-of-way from aesthetic and wildlife points of view.

Cover crops have disadvantages as well. Tall grasses and shrubs remain wet after a rain or heavy dew adding to the problems of patrols. They also obscure rocks and holes on rough terrain.

Qualitatively it is obvious the cover crop program is a success and encouraging reports from our field crews are now being received as how it reduces the cost of the selective herbicide program.

HAMILTON, R., FRASER, W.W. A Case History of Natural Underwater Revegetation - Mandy Mine High Sulfide Tailings. Hudson Bay Mining and Smelting Company Limited, Flin Flon, Manitoba.

The results of underwater impoundment of high-sulfur base metal tailings with respect to its effect on aesthetics, erosion, and water quality has been determined by a study of the tailings area associated with the Mandy Mine in the Flin Flon, Manitoba, Canada, area.

After 32 years of underwater impoundment, the high iron and sulfur content material has oxidized very little. With no expenditures on rehabilitation or site maintenance, water quality is good, and aquatic animal and insect life has moved into the tailings area. Vegetation has colonized the area and has produced a mat of organic matter covering the entire surface of the tailings material.

OEHMICHEN, F. Reclamation and Stabilisation of Steep Slopes by Unrooted Wood Cutting. Department of Landscape Architecture, Universite de Montreal, 5620 Darlington Avenue, Montreal, Quebec.

As steep are the slopes defined, which are unstable and are susceptible to erosion without support.

The slopes in need for stabilisation are mostly man made through diverse cut and fill operations.

In cases, where erosion could be controlled by shrubs and trees, they are certainly the most economical material and the type which integrates most satisfactory visually and ecologically into the environment. But there is one big draw-back: the time the plants need to get established and to grow into maturity, or in this case into the wanted efficiency.

It is this need for immediate stabilizing effectiveness which led to development of the techniques with unrooted wood cuttings. The cuttings used are rods and branches from species with a capacity to root easily. The length can vary from 1'6" - 15' depending on available material, structural needs and construction methods. The tips of the branches should protrude 1" - 5" beyond the soil surface.

The material is implanted in wedge shaped trenches on a nearly horizontal base approx. 10^{o}inclined toward the slope.

The trenches can run horizontally or in areas with danger of water erosion diagonally.

Distance between trenches may vary between 5' - 15'.

Construction is possible on existing slopes or during landfill operations as part of the fill process.

Methods of construction:

1) Brushwood layers: rods and branches 1'6" - 3' long, for construction during landfill operations length of rods and branches is possible up to 15'. Rods and branches in condition to root are placed in the trench at 20 pieces/meter. As cover or fill serves the excavated material of the trench above. Fall is the preferable time for construction, spring is possible. The developing roots will replace the decaying branches fast enough. Above the surface the new sprouts and rods will form brushlike hedges and retain sliding soil and stones. Suitable plants are species of Salix, Cornus Sambucus, Populus.

2) Hedge-branch layer: combination of rods and branches in condition to root used together with shrubs and jung trees. The transition from pioneer shrub vegetation to the next forest stage is much faster and controlled. Needed material: 10 cuttings and 2 plants (shrubs or trees)/meter. Suitable plants for cuttings see 'Brushwood layers', suitable shrubs or trees: Acer negundo, Alnus, Populus, Prunus serotina, Quercus rubra, Hippophae,Rhus, Viburnum, Spiraea, Lonicera.

OGRAM, D.G., W.W. FRASER. Reclamation of High-Sulfide Tailings at Hudson Bay Mining and Smelting, Flin Flon. Hudson Bay Mining and Smelting Company Limited, Flin Flon, Manitoba.

Hudson Bay Mining and Smelting Company Limited has been producing primary copper and zinc at its operations located in Flin Flon, Manitoba, Canada since 1930. During this period an area of approximately 625 acres has been covered by high-sulfur metallurgical tailings material.

Since 1969, endeavors have been underway to enhance the aesthetics of these tailings by establishing a vegetation cover. Although initial results were encouraging and vegetation was established, further experimentation indicated that maintained growth was not possible. The primary problem was determined to be continual acid generation within the tailings, while other growth limiting factors included nutrient defficiency, harsh microclimate, and excessive quantities of soluble salts and toxic elements.

MALHI, S.S., M. NYBORG. Improving Nitrogen Fertilizers For Use In Revegetation of Distrubed Lands. Department of Soil Science, University of Alberts, Edmonton, Alberta.

Nitrogen is the most critical nutrient in agriucltural soils for growing of crops, and disturbed lands are usually even lower in nitrogen than agricultural lands. Work in the Prairie provinces has shown that there are often serious losses of fall applied nitrogen fertilizers. These losses are apparently primarily by denitrification, but leaching may occur as well.

Some types of disturbance, consumes large amounts of available nitrogen; spills of elemental S, oil spills, and condensate spills. In other situations, disturbance may leave highly permeable soils (sand) or impermeable soils (dispersed type clays), which are conducive to leaching and denitrification respectively. Disturbed lands by and large are subjected to nitrogen losses more than agricultural lands.

In revegetation of diturbed lands, for efficient use of nitrogen, fertilizers should be applied frequently. Single heavy applications of nitrogen fertilizers may result in considerable losses through denitrification or leaching of nitrogen (a property of nitrate ion as opposed to ammonium ion). Single heavy application would be made more practical if nitrification inhibitors are used with ammonium-based fertilizers.

In our work with fall application of nitrogen fertilizers, inhibitors of nitrification suppressed nitrification of ammonium-based fertilizers, and improved over-winter conservation of nitrogen fertilizers and subsequent crop yields. There were considerable over-winter losses from fall applied nitrogen when no inhibitors were used. A slow release nitrogen fertilizer (S.C.U.) was found not as effective as urea + thiourea (thiourea - a nitrification inhibitor) in over-winter conservation of fall applied nitrogen.

There are a number of nitrification inhibitors, but only one or two are at their beginnings of practical use. Probably, for disturbed lands, ultimately the ideal nitrogen fertilizer would have the properties of slow release and nitrification inhibition.

MARTENS, H. E., W.E. NICHOLSON. A Soil and Vegetation Inventory of Coal Mining Wastes in the Rocky Mountain Region of Alberta and British Columbia. R.M. Hardy & Associates Limited, 635 - 11th Avenue N.E., Calgary, Alberta.

An inventory of the chemical, physical and biological characteristics of actual and potential coal mine wastes was carried out at three sites in the foothills and front ranges of the east slopes of the Canadian Rocky Mountains. The areas studied were the Kaiser Mine, located 32 km north of Fernie, B.C.; the McIntyre Porcupine Mine, located 13 km north of Grand Cache, Alberta; and the Granridge Mine lease, located 38 km north of Coleman, Alberta.

The physical properties of the waste materials appear to present the greatest problems to revegetation efforts. These materials are very coarse textured and as a result have low soil mositure retention capacities, high bulk densities and low cation exchange capacities. In addition, these materials are generally dark in colour which results in high surface temperatures during summer months. These factors combine to yield a seedbed that is relatively inhospitable for plant growth. The natural soils, with larger amounts of fine material and lighter soil colours, appear to be more favourable to plant growth. Thus, where possible, reclamation operations should include the stockpiling of the natural soils for use as caps on the dormat waste piles.

The chemical properties of the waste materials do not present major problems for revegetation. These sites appear able to supply all of the required nutrients except N, P and K, and do not appear to have acid or plant related toxicity problems. Nutrient deficiencies can be overcome by fertilization.

Studies of the vegetation of mine waste material showed that seeding and fertilizing the waste material produced a vegetative cover which after 2 years was similar to that produced by natural invasion on a site 35 years old. The most successful seeded species were: Medicago sativa, Poa spp., Agropyron cristatum, Lolium perenne and Triflorum spp. The most successful colonizers were Chrysanthemum leucantheum, Taraxacum spp., Phleum pratense, Poa spp. and Fragaria spp.

MOORE, T.R., R.C. ZIMMERMANN. The Reclamation of Asbestos Mine Wastes. Department of Geography, McGill University, 805 Sherbrooke West, Montreal, Quebec.

The production of 1 ton of asbestos fibre in southeastern Quebec requires the disposal of about 60 tons of waste rock and overburden and about 35 tons of tailings. The waste rock and overburden are relatively easy to vegetate, but the tailings are essentially bare of vegetation, even when exposed for up to 60 years. The tailings cover 5.5 km^2 and occur as either flat topped or conical mounds, with side slopes of 35 to 40^o. The establishment of a vegetation cover on the tailings is desireable from an aesthetic viewpoint, as well as to reduce health hazards associated with the aeolian or fluvial erosion of asbestos fibres.

The tailings are coarse textured, have low available water capacity (0.8cm/10cm), are subject to rainsplash erosion and can possess a surface crust. The tailings are alkaline (pH 9.2), have very low C, N and available P contents, low Ca:Mg and K:Mg ratios both in the saturation extract and on the exchange complex and are able to replace soluble Ca with Mg. Acidification of the tailings lowers the Ca:Mg and K:Mg ratios and below pH 8.5 the saturation extract contains potentially toxic concentrations of Ni and Cr and has a conductivity $>$ 4 mmhos/cm.

Field trials have established that 1 kg/m^2 NPK fertiliser (9-11-9) and 4 kg/m^2 organic matter (either farmyard manure or sawdust) are required to produce acceptable plant growth (90% cover sustained for 3 years). Acceptable growth has also been obtained with sewage sludge at 5 kg/m^2 and fertiliser at 0.5 kg/m^2. Topsoil is an alternative method on flat areas, but requires a thickness of at least 15 cm. Of 17 species grasses and legumes tested, only 7 have been successful (perennial ryegrass, Kentucky bluegrass, Russian wildrye and smooth brome and alfalfa, alsike clover and white sweetclover). Many plants show symptons of nutrient deficiency and tissue analyses have revealed N to be the major deficient nutrient, subsequently confirmed by supplementary fertilisation. Experiments with sulfur-coated urea are being conducted to combat this problem. Heavy metal toxicity does not appear to be a major problem, though some chlorotic plants have Ni and Cr concentrations in the probable toxic range.

Tree seedling growth has been poor in both treated plots and in small holes filled with fertiliser and organic matter; trembling aspen is the most successful species.

The cost of treatments necessary to produce adequate (90% cover) long term ($>$ 3 years) growth is in the range of $2500 - $3500/ha.

MCLELLAN, A.G. Man induced Landscape Changes - The Preplanning Process in the Urban Periphery. Faculty of Environmental Studies, University of Waterloo, Waterloo, Ontario.

Since the end of the Second World War, societal demands have precipited and umprecedented flight to the suburbs. Even after the boom years of the 1960's it is still estimated in the U.S. today, that 300 acres of land in the rural urban fringe is being converted to urban uses every day. In Canada the conversion of rural to urban acres is possibly proportionally even greater.

The content of the paper is really meant as a challenge to those of us who in our academic careers or our business lives, are involved with the processes of landscape change. Here we have throughout Canada on the thresholds of our cities, a massive acreage of very expensive, highly accessible land which society demands be transformed -- how is it being done -- what is happening to the landscape, why and how might the transformation be improved to optimize the qualities and profitabilities of the proposed developments?

The paper separates out only one of the many themes which might be discussed -- the physical landscape transformation -- some statistical analysis is done and conclusion drawn. The current situation is discussed and a multiple resource use concept taken towards optimising the development procedure.

Two case studies are used to demonstrate the benefits involved of physical pre-planning surveys -- a recreational park development and a 200 acre sub-division. Cost-benefit analysis of the economics involved alone demonstrates the superiority of having prior information which permits sensible and sensitive decisions to be made. The conclusion is that we have a responsibility to initiate and implement such improvements which until the present, we have failed to live up to.

MURRAY, D.R. Reclamation by Vegetation. Energy, Mines and Resources Canada, Elliot Lake Laboratory, Box 100, Elliot Lake, Ontario.

Canada has a long history of mining and accummulating mine wastes. These wastes are traditionally of less importance than the product being mined. However, increasing public concern for the environment, and the increasingly large scale of open pit operations in particular, mean mine wastes are becoming more and more significant to the mine operator. Environmental problems associated with these wastes include wind erosion, water erosion, water course contamination and poor aesthetics. Little is so far known about the ability of these wastes to support vegetation.

In 1974, the Canada Centre for Mineral and Energy Technology (CANMET, formerly Mines Branch), Energy, Mines and Resources Canada, initiated a three year study to examine the potential of vegetation for reclaiming mine wastes. Research contracts to study the characteristics of over fifty mine sites in Canada were placed with industry, consultants and universities. The value of these contracts was about three hundred thousand dollars. The work scope included evaluating the physical, chemical and biological characteristics of wastes and mine environments. The information collected provided the basis for identifying problems associated with establishing vegetation on mine wastes.

The results of the study are being published as a supplement to the Pit Slope Manual of CANMET. The supplement describes the three major waste types - overburden, waste rock and tailings. Characteristics of each group are explained in relation to their importance and how they affect vegetation.

At least fifteen characteristics of each waste have been studied, but only four of these have a major effect on a vegetation program. These are: climate, particle size distribution, moisture availability and waste mineralogy.

Case histories, maps produced by Satellite imagery and additional references are given to assist the mine operator. Attention has been given in many cases to methods currently used for vegetation. Often short term results have been sought, but the need for long term planning must be recognized. The experience of others is always valuable, but cannot be relied upon to guarantee success, nor should it be used as an excuse for failure.

The supplement is not intended as a field guide for growing vegetation, but rather will give direction in evaluating various types of vegetation for purposes of reclamation. The intent is to give the operator adequate information so that he may realize his capabilities and limitations in evaluating vegetation for reclamation. It is intended also to foster recognition of the value and economic advantages of using vegetation in the treatment of mine wastes.

NYBORG, M., S.S. MALHI. Reclamation of Forest Soils Acidified by Elemental S or SO_2. Department of Soil Science, University of Alberta, Edmonton, Alberta.

The gas processing of sour natural gas in Alberta, produces about five million tons of elemental sulphur (S) annually. The handling and loading of S generates some windblown S, which is deposited locally. The heavy depositions of S, after its oxidation to sulphuric acid, can result in extremely acid soils with a pH, S of 1 to 3. On grasslands or on agricultural lands, the problem of revegetation is easily overcome by the application of very high rates of finely ground limestone and fertilizers. In forests, the acidification by S may have progressed to the extent that all vegetation including trees have been killed, and for revegetation the areas need to be cleared in order to work the lime into the soil before fertilization and initially planting to grass.

In forests, where acidification have not proceeded to the extent of lowering soil pH much below 2.5, all undergrowth has been killed, but some tree species still survice (aspen, pine and spruce). In such areas the topdressing of finely ground limestone will work its way down in the order of an inch annually, thus neutralize the top soil and allow regrowth of some ground vegetation. Finely ground limestone has been found to induce moss growth on the acidified soils, and in fact even moss growing on normal forest soils are not harmed by topdressing of ground limestone at low rates.

On a different topic, SO_2 has been found to acidify soils at a very slow rate over extensive areas in Alberta as well as other parts of the world. It seems that in Alberta, soils acidified by SO_2 in forested regions may overcome by simply topdressing very low rates of ground limestone.

ROWELL, M.J. Reclamation of Some Organic Soils and Mineral Agricultural Soils in Alberta Effected by Crude Oil. Norwest Soil Research Limited, 6788 - 99th Street, Edmonton, Alberta.

Difficulties associated with oil spills are often quite different in mineral and organic soils.

In mineral soils problems are partially due to poor wettability and water holding and to the breakdown of soil aggregation while in organic soils problems are normally associated with excess moisture.

Poor germination, restricted plant growth and severe nutrient immobilization are common to both types of soil.

Other problems such as crusting, waterlogging and poor natural regeneration may be related to specific primary cleanup measures.

Reclamation measures should be based on a good understanding of the effect that oil has on soil at the microbiological and chemical level.

Successful methods so far tried have included heavy fertilization, aeration, optimizing the timing of seeding and the introduction of native material into barren areas.

REYNOLDS*, J. CWIK, E. KELLEY. Reclamation at Anaconda's Jackpile Uranium Mine. *The Anaconda Company, New Mexico Operation, Uranium Division, Box 638, Grants, New Mexico.87020.

Twenty-two years of open pit uranium mining in the semi-arid grasslands of northwestern New Mexico has resulted in 2300 acres of surface disturbance. A reclamation program to rehabilitate this surface disturbance includes overburden analysis, separation and selective deposition, and physical-vegetative stabilization procedures. Initial short-term revegetation pilot projects indicate that certain types of overburden can support native vegetation comparable to that of surrounding grasslands. Large boulders of shale and sandstone were crushed in place by heavy equipment to form the soils for the seed bed. Long-term results are needed to establish trends and overall success of stabilization efforts.

[1]Reclamation Supervisor for Anaconda's Jackpile Mine, Grants, New Mexico.

[2]Reclamation Specialist, Dames and Moore, Phoenix, Arizona.

[3]Plant Ecologist, PHD Candidate, University of New Mexico.

ROBINSON, J. K., A. G. MCLELLAN. The Development of an Evaluation Framework for Assessing the Success of Reclamation and Rehabilitation Programes in Surface Mining Areas. Graduate Student - Faculty of Environmental Studies, University of Waterloo. Associate Dean - Faculty of Environmental Studies, University of Waterloo.

The re-establishment of surface minable coal as an energy source is rapidly gaining significance in Canada's energy policy. The resulting surface mining impact will directly affect hundred of thousands of acres of Canada over the next 30 years, the significance of which should be of particular concern to Western Canadians. In the Plains region of Alberta alone an estimated 110,000 acres will be surface mined for the abstraction of subbituminous coal.

The flurry of published material on surface mining problems has not yet firmly addressed the topic of this paper. An ever expanding need for systematic assessment of reclamation/rehabilitation efforts is justified both for the sake of uniformity and because of the lack of universal appreciation for the reclamation process and evaluative criteria on the part of the coal mining industry and government regulators and monitors. Three methods of tackling the problem of assessing rehabilitation success are reviewed, (1) evaluative criteria used in other institutional programmes, (2) issue examination in empirical mining research, (3) legislative criteria.

Finally a framework is developed which can be used to assess the sucess of land reclamation/rehabilitation projects.

SAEED, M. Use of Sorption-Isotherms For Evaluating Effect of Leonardite On P Availability in Surface-Mined Spoil Materials. University of North Dakota, Box 8122, University Station, Grand Forks, N.D. 58202.

Phosphorus availability is one of the limiting factors for plant growth in surface mined areas of western North Dakota. The total P content of these soils is high as compared to unmined soils, but its availability is extremely low. The use of leonardite (low energy coal) has been suggested as a possible amendment to improve structure of the spoil materials and increase the productivity of plants.

The effect of leonardite application was studied on the availability of P in Glenharold spoil material. Phosphorus sorption-isotherms of leonardite and spoil material indicated greater P sorption by leonardite as compared to spoil material. The sorption maximum (P sorption capacity) of leonardite calculated from the linear form of the Langmuir equation was twice that of the spoil material. Spoil material with 10% leonardite sorbed 21% more P than spoil material.

A growth chamber experiment was conducted to evaluate the effect of leonardite application on plant growth and the utilization of applied P. Phosphorus fertilizer was applied as calculated from sorption curves to establish 7 levels of P in equilibrium solution: 0, 0.05, 0.1, 0.2, 0.4, 0.8 and 1.6 ppm P for spoil material and 0, 0.035, 0.06, 0.145, 0.25, 0.5 and 1 ppm P for spoil material+10% leonardite. Thickspike wheatgrass *(Agropyron dasystachum)* was grown for 5 weeks in pots containing spoil material, and spoil material+10% leonardite. Marked response was obtained to applied P. The yield increased with increasing levels of solution P upto 0.2 ppm in the case of spoil material and upto 0.145 for spoil material+leonardite. Increasing P levels in equilibrium solution did not further increase the yield. Leonardite application depressed grass growth at all P levels. At the optimum P level (0.2 ppm), the yield was decreased by 20% of the maximum. Uptake of P by plants followed trends similar to yields. Addition of leonardite significantly reduced P content of, and P uptake by thickspike wheatgrass. Bray's extractable soil P levels were somewhat reduced in the presence of leonardite. Apparently high P adsorption by leonardite and its subsequent low desorption from the sorbed phase to replenish depleted P in solution resulted in reduced plant growth and lower uptake of P by the wheatgrass.

After the harvest of thickspike wheatgrass, the pots were replanted with alfalfa *(Medicago sativa)* without further additions of P. Three crops of alfalfa were obtained. The yields increased in relation to the amount of residual P remaining in the pots. Addition of leonardite improved the growth of alfalfa without affecting the uptake of P. The effect on yield was more pronounced in the last crop. With leonardite the yield was increased by 5 to 15% for the first crop and by 4 to 37% for the third crop. A substantial increase in the utilization of indigenous Zn and Mn was also observed with leonardite application. The results suggest that greater availability of native Zn and Mn in the presence of leonardite may result in the improved growth of alfalfa. *(Supported by Grant No. G0264001 from the USDI, Bureau of Mines)*

SAFAYA, M.N., KOLLMAN, A. Responses of a Grass-Legume Mixture To Various Amendments and Nutrients On A Sodic Spoil Material. University of North Dakota, Box 8122, University Station, Grand Forks, N.D. 58202.

The newly surfaced spoil material at Glenharold coal mine, near Stanton in Western North Dakota is dominated by Na-affected montmorillonitic clay. It is moderately saline (EC_e: 2.55 Mmhos) and highly alkaline (pH: 8.78, exchangeable Na > 30%); exhibits water infilteration problems and has a very low P and N fertility status. Since these factors contribute to a highly unproductive medium for plant growth, the amendment and fertilizer requirements of the spoils were investigated by conducting growth chamber experiments. The relative efficiency of different treatments was measured in terms of effects produced in spoil properties, and on the growth and chemical composition of thickspike wheatgrass and yellow sweet clover grown as a mixed crop.

Fertilizer (NPK) application increased the dry matter yield (DMY) of grass and legume by 10 and 37 times respectively. The two species exhibited a differential growth response to leonardite (highly oxidized low energy lignite). Thickspike wheatgrass was adversely affected whereas sweet clover showed maximum growth when supplied with NPK+ leonardite. Gypsum and Zn had no beneficial effect on either species but alleviated significantly the growth depressing effect of leonardite on thickspike. The fertilizer effect on sweet clover was found to be essentially due to P and inclusion of N with P usually depressed the yield of this species. Thickspike wheatgrass gave a better response to N+P than P alone, and in the presence of N, the growth depressing effect of leonardite was also less pronounced. Sulphuric acid (@5.7 mT/ha) increased DMY of thickspike to nearly the same extent as did the application of 75 ppm P; and increased the P concentration in plants especially sweet clover. Severe deficiency of P as a limiting factor in the spoil was confirmed by very low P status of control plants. Concentration of K in sweet clover was higher as compared to thickspike and it decreased significantly with P fertilization in the latter species. Manganese concentration of NPK supplied thickspike plants was low. Gypsum increased Mn and Zn concentration in plants which correlated with water-extractable Mn and Zn status of the spoil. Zinc and Cu concentration in plants was decreased with P fertilization. Sulphuric acid as an amendment for Glenharold spoil appears to be promising in view of its ability to increase P availability to some extent and through its expected role in improving the infilteration characteristics. Leonardite will help legume growth which in turn should improve the N status of the spoils. (*Supported by Grant No. G0264001 from the USDI, Bureau of Mines*)

SHUBERT, E. L. Algal-Soil Relationships of Surface Mined Areas in Western North Dakota, Northern Arizona and New Mexico. Department of Biology and Project Reclamation, University of North Dakota, Grand Forks, ND 58202.

Soil algae can be an important component in successional processes, since they are primary colonizers on barren, infertile, denuded soils, as consolidators of the surface by forming a soil crust, and producers of surface humus after death. The presence of nitrogen-fixing blue-green algae, such as *Nostoc commune*, may be important as an inoculant in the soil for increasing fertility and enhancing the growth of higher plants.

Topsoil and spoil samples from the top 10 cm were collected aseptically from the Beulah, Center and Glenharold mines (North Dakota) during 1975 and from the Black Mesa mine (Arizona) and San Juan, Navajo and McKinley mines (New Mexico) during 1974. The samples were stored in sterile whirl-pak bags. Using the enrichment culture technique, one gm of soil was combined with 10 ml of modified enriched Bristol's medium and incubated under standard environmental conditions. Eleven algal species were identified from a total of seven different sites. All soil samples were analyzed for a total of 54 variables, including cations, anions, trace elements, and particle size. Standard methods of analysis were used throughout. The NT-SYS statistical package was employed to determine similarities in algal-soil relationships.

The most common algae were *Chlorococcum* sp., *Anabaena flos-aquae* and *Chlorosarcinopsis psuedominor*. The least common algae were *Chlamydomonas* sp. and *Golenkinia* sp. Other algae, moderately common, included *Lyngbya* sp., *Nostoc commune*, *Nitzschia* sp., *Chlorella* sp., *Oscillatoria* sp. and *Phormidium* sp.

Specific differences can be determined by an analysis of the correlation matrix. Comparison of two variables that were highly significant ($P \leq .01$) to one another (EDTA extractable iron (Fe) and copper (Cu)) demonstrated that San Juan spoil sample A clustered with McKinley and Navajo topsoils (low Fe and Cu), and the other San Juan spoil sample B (high % clay) was isolated from all other soils and quite high in Fe and Cu. Navajo and McKinley spoils grouped together.

The Beulah spoil and Center topsoil were statistically grouped by algal genera. The Center and Glenharold spoils grouped with the Arizona and Nex Mexico soils. By this grouping, the latter soils from different groups than those obtained on the basis of chemical properties, since topsoils and spoils each grouped together regardless of site. A regression of % saturation on replaceable sodium (Na) revealed that topsoils from all 3 states were lower in % saturation and Na than their relative spoil materials. The latter represent harsher sites (includes San Juan site B), and may account for some genera similarities and differences.

Analysis by the phenogram method demonstrates that it is important to take a functional look at the soil ecosystem by studying both the abiotic and microbiotic components simultaneously. This information will provide valuable data on natural algal-soil relationships which may be useful to the reclamation process of surface mined lands. *(Supported by Grant No. G0264001 from the USDI, Bureau of Mines)*

WALI, M. Reclamation Upon An Ecological Basis. The University of North Dakota, Box 8122, University Station, Grand Forks, ND 58202, U.S.A.

In recent years, it has become clear that mining for more coal will be necessary to meet the increasing energy needs of the many industrialized nations. To ensure long term biological productivity and stability, the process of revegetating the spoil materials after coal extraction, must be approached through an ecological understanding of the numerous interacting factors involved. Project Reclamation, studying the sites in western North Dakota coal fields, utilizes such an ecological and systems approach. Specifically, quantitative information is being gathered on several subprojects summarized below.

1. The process of plant succession on a series of spoil banks is being documented by studying quantitative changes in species composition as a function of time, parent materials and topography. A time gradient of about 50 years is being used. 130 species-specific distributional diagrams have been generated and correlated with important soil variables. This should aid greatly in species selection for revegetation in relation to various reclamation and management practices adopted.

2. The use of leonardite (low energy, oxidized coal) as a soil amendment has shown great promise in enhancing the process of revegetation both in field and laboratory conditions. Growth chamber experiments with wheatgrasses, alfalfa and sweet clover have indicated that legume growth on spoil material is considerably improved with leonardite application.

3. Other amendments tested range from conventional fertilizer and gypsum treatments to the use of sulphuric acid. Preliminary results indicate sulphuric acid to be a better amendment for sodium affected clay spoils.

4. The available nutrient status of spoil materials is being worked out. In addition to major and micronutrients, several other trace-elements with implications in plant and animal nutrition are being studied. The effects of various amendment and other treatments on the availability of these nutrients is assessed by following both soil and plant analysis.

5. Although total phosphorus levels are high, available P in the mine spoils have shown this to be a major growth limiting factor. Radiotracer studies are in progress to show the diffusion patterns of ^{32}P in relation to amendments. Ways by which fixed levels of P could be mobilized are being studied. Diffusion models have been generated using calcium phosphate as a source.

6. Several autecological studies are underway to study the grass-legume, and desirable-nondesirable species interactions. The allelopathic influences of several species that dominate the spoil materials have provided interesting preliminary data on species selection.

7. Water chemistry and organism diversity of various impoundments are being studied along a time gradient. Our studies have shown that newly formed ponds in surface mined areas rapidly become similar to the ponds in the unmined areas as is reflected by their chemical nature and the types of species that inhabit them.

8. Microbial relations of these spoil materials are important. In particular, soil algae, which have been cited as important primary colonizers on infertile, denuded soils and as consolidators, are being studied at all the sites. The potential use of blue-green nitrogen fixing algae as soil inoculants is being emphasized.

9. At the field sites, microclimatic monitoring stations have been installed to provide data on soil and air temperatures, incoming solar radiation, precipitation and wind, and other variables that are important in the study of plant growth.

10. Using the variables generated from studies 1-9, it is our hope to generate predictive ecological models that can simulate environmental stresses and perturbations in relation to plant growth on these spoil materials. At present, data are being analyzed by statistical techniques. Significant parameters obtained through this first step, will be used to generate mathematical models. *(Supported by Grant No. G0264001 from the USDI, Bureau of Mines)*

WATKIN, E.M. Vegetation Potential of Tailings Containing Iron Sulphides.
Department of Crop Science, University of Guelph, Guelph, Ontario.

A co-operative project between the University of Guelph and Noranda Mines Ltd. (Horne Division) is concerned with establishing vegetation on mine tailings containing varying levels of iron sulphides. Through laboratory, growth room and on-site studies, the project is attempting to achieve a number of objectives: the establishment of vegetation on tailings where oxidation of sulphides has occurred over a 20-year period, and a highly acid environment (pH range 1.5 - 3.0) has developed; the effect of vegetation and/or chemical treatments in reducing the oxidation of iron sulphides and subsequent formation of acid in newly deposited tailings; the characterisation of tailings composition in order to predict the degree of difficulty likely to be encountered in vegetating new or old tailings and future tailings from ore bodies containing iron sulphides.

Several methods of amending acid tailings have been developed through growth room and on-site studies. Amendments include agricultural limestone, rock phosphate, anhydrous ammonia and fly ash. Research is continuing on the use of precipitator dusts from the cement and phosphate fertilizer manufacturing industries and a number of other chemicals. Because of variation of unknown causes, both between and within tailings deposits, the efficacy of the above amendments is very variable. At this stage it is not possible to make specific recommendations on the use of the amendments in large scale reclamation projects.

The use of vegetation and/or chemical treatments to prevent the oxidation of iron sulphides in newly deposited tailings is still uncertain. Nevertheless, laboratory and growth room studies have provided sufficient indication that such an approach is worthy of further investigation.

Analytical methods commonly used in mineralogical and soil chemistry analysis have so far failed to distinguish between tailings known to have a high, medium or low vegetation potential. However, a recent study has indicated that the morphology of the iron sulphides in the tailings being investigated varies very distinctly both between and within tailings sites. The significance of such variation is presently being assessed.

WINTERHALDER, K., MCAULEY, I.A., MCGINN, S.M., MICHELUTTI, L.A., RAPUNDALO, S.S.
Composting of Municipal Wastes for Use in the Reclamation of Industrial Barrens.
Department of Biology, Laurentian University, Sudbury, Ontario.

Although many refuse composting plants in North America have been closed down for economic reasons, the installation of a refuse grinding and composting plant in the Sudbury area may still be justified if the use of composted refuse can be shown to be feasible as an aid in establishing vegetation on the Region's extensive industrial barrens.

Experimental composting was carried out with a number of different substrate combinations, using cubical composting boxes each having a volume of 8 cubic feet. Forced aeration was provided and the compost was mixed daily by hand. Ground refuse from the single-stage mill at St. Catharines was used as the principal carbon source, and was mixed with various amounts and combinations of farmyard manure, ammonium nitrate, urea, sewage sludge slurry and centrifuged sewage sludge "cake" to give an initial C:N ratio of 30:1 and an initial moisture content of 50%. Temperature and moisture content were monitored daily, and pH and C:N ratio were determined periodically during the composting process. Thermophilic cellulolytic microorganisms were monitored during composting and a quantitative estimate of coliform bacteria made at the end of the process.

Successful composting occurred in all substrate combinations, though heating and speed of composting varied considerably between treatments. Most rapid composting occurred when sewage sludge was added to ground refuse in small portions, in the absence of other nitrogen sources, over a period of three weeks. Other composts took five weeks to stabilize, the poorest being the refuse/sewage "cake"/urea combination.

The finished composts were used to set up field trials on barren soils at Coniston, Skead and Sudbury (West End). Compost was incorporated into a top 10 cm of soil at a rate of 5 litres per square metre, and a seed mixture of eleven species was sown. Germination occurred in September 1976 and plant growth, together with soil pH, organic matter content, nitrogen content and phosphorus content, will be measured in summer 1977.

A greenhouse growth trial was also carried out, in which soils from the same barren areas were combined with composts made by Dr. Jack Pos of the Engineering Department, University of Guelph. These compost had been made from a variety of substrates, including aquatic weeds, hardwood bark, poultry manure and paunch manure. All composts gave significantly improved growth of Redtop (*Agrostis gigantea*), even without liming or fertilization.

Two major problems were encountered during the composting study. Pieces of plastic film in the refuse interfered with mixing of the compost and difficulty was experienced in maintaining a stable moisture level. The former problem would be eliminated by two-stage grinding of refuse, as proposed for the Sudbury facility, while the latter problem, due mainly to poor insulation of the composting boxes and loss during manual mixing, would not occur in an enclosed digester.

Results obtained so far suggest that the establishment of a refuse grinding and composting plant in the Sudbury Region, with a view to using the product in reclaiming industrial barrens, is a practical proposition. It is hoped that the results of the field trials, to be observed in 1977, will support these conclusions.

YOUNKIN, W.E. Seeding Trials in the MacKenzie Delta Region, N.W.T.
R.M. Hardy & Associates Limited, 65 Springwood Drive, S.W. Calgary, Alberta.

The proposed Canadian Arctic Gas pipeline to bring gas from Prudhoe Bay and the MacKenzie delta to markets in southern Canada and the United States will extend over 2500 miles from the Arctic ocean to the U.S. border and cross numerous geographical and environmental boundaries. Studies into methods of revegetation areas disturbed by construction activities have been underway since 1971. Research emphasis has been in permafrost regions where conditions of a short, cool growing season, low soil nutrients, low precipitation and a shallow, cool root zone retard plant growth and establishment. Some of the earliest studies were species and fertilizer trials established at CAGSL's Sans Sault test facility and those in the delta established by the University of Alberta. From these species were selected for inclusion into a seed mix trial on an abandoned rig site in the Mackenzie delta region. The objective of these initial seed mix studies was to test the success of various seeding rates of a 2:2:2:1:1 mix of Nugget Kentucky bluegrass, Arctared creeping red fescue, Engmo timothy, Frontier reed canary grass and Prolific spring rye and selected component species of that mix in terms of winter survival, seeded cover and litter production and encouragement of invasion by native species. The results of the first three years of this study have shwon the following:

1) The 2:2:2:1:1 mix is not entirely winter-hardy in the MacKenzie delta region but can provide 30 to 50% cover the first year and 10 to 30% litter cover the second year. The third year seeded cover increased substantially but was provided entirely by Arctared fescue and Nugget bluegrass.

2) Most of the initial cover provided by the 2:2:2:1:1 seed mix is provided by timothy which, though not very winter-hardy, provides a rapid cover for immediate erosion control and a heavy litter layer the following year.

3) Nugget bluegrass and Arctared fescue, the two most winter-hardy species in the seed mix are considerably refuced in cover when added in low proportions with faster growing but less hardy species. When slower establishing but longer lived cover is adequate these species simply or in combination are recommended. However dense stands of these two grasses will inhibit native invasion.

4) If both a rapidly establishing and longer lived cover is required, a mix of Nugget bluegrass and Arctared fescue with a one-fifth proportion of timothy is suggested for the delta region.

5) As living cover of seeded species increased above 40% the cover of invading native species decreased. Where native invasion is to be encouraged, less winter hardy species such as timothy, applied at light seeding rates would appear to the best.

YUNDT, S. Agricultural Rehabilitation of Extractive Areas in Britain, Germany and Ontario Past, Present and Future. Ministry of Natural Resources, Toronto, Ontario.

The recent pressure in all countries of the world to preserve agricultural land to provide food to an ever increasing population, is beginning to add pressure to the extractive industries.

There are many types of rehabilitation for extracted areas such as recreation, housing, forestry, nature conservation, water areas and agriculture. Agricultural rehabilitation is most advanced in Britain and West Germany and several specific examples are outlined. Ontario is only in its infancy as far as agricultural restoration is concerned, although there are signs that the number of acres returned to productive agriculture land will increase in the future.

In Britain for the years 1971, 1972, 1973 -- 3401 acres of land were returned to agriculture to a grade of agriculture at least equal to the grade prior to extraction of sand and gravel. In west Germany brown coal deposits are extracted from the most fertile farm land in Germany, with whole villages removed and returned after coal extraction.

The technology is available to return land to any class of agricultural land and Ontario can certainly learn from the many European examples.

ZIEMKIEWICZ, P.F., S.M. NORTHWAY. Methods of Predicting the Success of Thirteen Revegetation Species on Coal-Mining Disturbed Lands in Southeastern British Columbia. Faculty of Forestry, University of British Columbia, Vancouver, British Columbia.

Reclamation of coal-mining disturbed lands has been proceeding since the late 1960's in southeastern British Columbia. Much of the disturbance has occurred in the Elk River Valley in the vicinity of Sparwood, British Columbia. However, little work has been completed concerning the fitness of the many grass and legume species to the varied environments to which they were sown. Since reclamation plant communities were already established, and the need for a planting guide immediate, it was decided to attempt analysis of existing species distribution and attempt correlation to environmental factors.

Two types of multivariate analyses were employed in this study. They yielded potentially useful species production response surfaces as well as many highly correlated prediction equations. These findings enhance our ability to predict which species of the thirteen tested will successfully grow on a given reclamation site.

STOBART, E.W., A. RAMSAY, Restoration of Agricultural Productivity Along a Major Pipeline Right of Way. Bechtel Canada Limited, 6205 Airport Road, Building A, Suite 304, Malton, Ontario.

Construction of the 520 mile Interprovincial Pipeline Ltd., extension from Sarnia to Montreal began in September 1975. The 30 inch diameter line was constructed in variety of agricultural lands from the area of heavy clay soils in Southwestern Ontario, which supports cash crop and meat producing operations, to an area in Eastern Ontario and Quebec, where corn and forage crops are grown on heavy marine clay soils for dairy production.

Unfortunately as soon as construction began, the previous good weather conditions deteriorated and prolonged rainfall was experienced in many areas along the right of way. This together with the heavy equipment normally used in pipelines construction caused specific soil problems in certain areas.

A program was developed to restore the productivity of agricultural land to its original level. It was recognized that this program could take a number of years to be fully effective.

This paper discusses the organization of the overall program and the implementation of the initial phase during 1976, including soil testing and the prescribing and implementing of restorative measures.

VALLEAU, R.J. Alberta Environments' Approach to Land Reclamation. Land Conservation and Reclamation Division, Alberta Environment, Calgary, Alberta.

Alberta Environment is utilizing a three phase approach to achieve a satisfactory standard of land reclamation in Alberta. Since the formation of the Department in 1971, the attitude of both government and industry has been markedly affected by the successful application of this approach.

Preventative Review Phase - Phase 1

This was initiated in 1973 with the passing of the land Surface Conservation and Reclamation Act. This act formalized a preventative review program which potentially covers every form of surface disturbance operation in the Province. Review procedures can occur through formal interdisciplinary committees or through inter-departmental referral systems. Review may be aided by Environmental Impact Assessments, where necessary. The key factors found to be crucial to the success of this phase are:

(1) review processes must minimize paper flow and must be streamlined but at the same time flexible enough to achieve complete review coverage

(2) there must be effective communication and co-operation among review agencies

(3) there must be effective communication and co-operation between review agencies and proponent

Development Planning Phase - Phase 11

The second phase in this approach to land reclamation is the Development Planning Phase. It is entirely dependant on a close working relationship between government and industry and is directed towards mutual problem solving. It generally takes the form of consultant studies directed by a steering committee made up of upper and middle management members from both government and industry. The success of this phase is largely measured by the development of problem solving attitudes of steering committee members and consultants. Examples of projects initiated so far are:

(1) Villeneuve gravel study, where an attempt is being made to develop a hudge gravel reserve north of Edmonton with minimal impact to the public and the physical environment

(2) Materials Handling Study, where alternative strip mining methods in prairie areas are being evaluated to achieve minimum extraction costs and maximum environmental protection

(3) Crowsnest Pass Coal Waste Utilization Study, where alternative uses of waste coal piles are being evaluated to determine market potential. If successful, the environment of the Crowsnest Pass will be improved by the removal of the piles and a market for otherwise useless material will be found.

Derelict Land Program - Phase 3

The derelict land program, initiated in 1973, is the last phase in our approach to land reclamation. The purpose of the program, is to rectify as much as possible, evidence of poor land management practices commonly used in the past. To date, the program has levelled, drained, regraded, topsoiled, and revegetated several thousand acres of abandoned coal mines, garbage dumps, gravel pits, exploration trails, pipelines, old road beds, oil sands sites, and abandoned sewage lagoons. Some have been improved for agricultural use or for asthetics. Others have become recreation, residential, or industrial sites. Still others have proved next to impossible to properly reclaim without extensive research. Even these areas are useful as stark reminders of the irreversible damage to the land which man can cause and clearly reinforce the need for the other two phases of our reclamation approach.

WAGNER, W.L. [1], W.C. MARTIN [1], E.F. ALDON [2]. Natural Succession on Strip-mined Lands in Northwestern New Mexico. [1] Biology Department, University of New Mexico, [2] Rocky Mountain Forest and Range Experiment Station, Albuquerque, New Mexico, 87101.

Plant species composition and diversity were compared on mined and unmined areas at the McKinley Coal mine in New Mexico by a reconnaissance survey. Mined sites sampled date from 1961 to 1972. The unmined sites were adjacent to the mined sites. Vegetation was surveyed with respect to life forms and relative importance of each floristic element.

The data show the slow rate of recovery of untreated mined lands within this semi-arid sagebrush/pinyon-juniper plant community. Mined sites of all ages are considered to be in a similar phase of early primary succession as shown by dominance of annual and short-lived perennial taxa in a region naturally dominated by woody taxa. No significant differences in species diversity was found between mined sites of different ages. Greater species diversity was found in unmined areas.

CONFERENCES AND SEMINARS - 1977 - 1978

Canadian Land Reclamation Association Annual General Meeting, Edmonton, Alberta, August 17 - 20, 1977. Details from T. Laidlaw, (Co-ordinator), C.L.R.A., P.O.Box 4666, Edmonton, Alberta T6E 5G5.

Committee for High Altitude Revegetation Summer Field Tour, Aspen, Colorado, August 17-18, 1977. Details from S. Kenny, Agronomy Department, Colorado State University, Fort Collins, CO 80523.

Ecology Consultants Inc. "Planning Western Surface Mine Reclamation for Wildlife" Workshop, September 19-20, 1977, Colorado State University, Fort Collins. Details from R. Moore, Ecology Consultants Inc., Box 2105, 1716 Heath Parkway, Fort Collins, CO 80522.

International Congress for Energy and the Ecosystem

Economics, Ecology and Planning of Coal Resource Development. June 12-16,1978. University of North Dakota, Grand Forks, ND. Sponsored by the University of North Dakota, University of Arizona and the United States Department of the Interior - Bureau of Mines.

Those interested in attending, please send a postcard: those interested in presenting papers should send a 200-word abstract to the International Congress Headquarters, Box 8122, University Station, Grand Forks, ND 58202 USA.

Canadian Land Reclamation Association

BOX 682 GUELPH ONTARIO CANADA N1H 6L3

OFFICERS FOR 1976 - 1977

President: J. E. Winch, Crop Science Department, University of Guelph, Guelph, Ontario N1G 2W1

Vice President: J. V. Thirgood, Faculty of Forestry, University of British Columbia, Vancouver, B.C. V6T 1W5

Secretary-Treasurer: E. M. Watkin, Crop Science Department, University of Guelph, Guelph, Ontario N1G 2W1

Executive Members: D. W. Abbott, Research & Productivity Council, Fredericton, New Brunswick. E3B 5H1

R. J. Berdusco, Kaiser Resources Ltd., Box 2000, Sparwood, British Columbia.

Bernard Brooks, Noranda Mines Ltd., Box 4000, Noranda, Quebec. J9X 5B6

T. F. Laidlaw, Alberta Environment Conservation Authority, Edmonton, Alberta. T6G 2M4

P. D. Lulman, Syncrude Limited, Edmonton, Alberta.

Reclamation Review:

Co-ordinating Editor - E. M. Watkin, Crop Science Department, University of Guelph, Guelph, Ontario N1G 2W1

Scientific Editor - R. W. Sheard, Department of Land Resource Science, University of Guelph, Guelph, Ontario N1G 2W1

Reviews Editor - T. H. Peters, Agricultural Division, International Nickel Company of Canada Ltd., Copper Cliff, Ontario.

News & Notes Editor - J. V. Thirgood, Faculty of Forestry, University of British Columbia, Vancouver, B.C. V6T 1W5

Canadian Land Reclamation Association

Minutes of the 1st Annual General Meeting

November 24, 1976 - University of Guelph

The President of the Canadian Land Reclamation Association (CLRA), J. E. Winch, called the meeting to order at 2.15 p.m. He welcomed the members who were present and gave a short opening address.

Minutes of previous meetings

Minutes of the previous meetings were circulated:

1. Persons interested in forming a Canadian Land Reclamation Association, 9/12/75.

2. To discuss proposal that the Ontario Cover Crop Committee be dissolved and replaced by the Canadian Land Reclamation Association, 10/12/75.

3. First business meeting of the Canadian Land Reclamation Association, 11/12/75.

The Secretary, E.M. Watkin, read selected highlights from these minutes, and then asked that they be adopted. Seconded by Brooks. Carried.

Adoption of Constitution.

Copies of the proposed constitution were circulated. The proposed constitution had been formed at the inaugural meeting in 1975 and circulated in the Proceedings of the Inaugural Meeting of the CLRA. The President requested that the constitution be accepted in order to place the annual general meeting on a formal basis.

Motion: That the constitution be ratified as printed (Brooks/Seraphim). Following discussion on various wordings, an amendment to the motion was made by Peter/Abbott that "The changes discussed be brought back from the Executive to the next annual meeting".

Motion and amendment were carried.

Discussion took place on the need to register or incorporate the Canadian Land Reclamation Association. The need and possible high cost of so doing was questioned.

Motion: - that power be given to the Executive to investigate the need for registration and/or incorporation, and if necessary to register or incorporate the Canadian Land Reclamation Association. (Peters/Dodds)

Motion carried, but not unanimously.

Treasurer's Report

The Treasurer, E.M. Watkin, presented financial statements covering the income and expenditures of the Ontario Cover Crop Committee and the Canadian Land Reclamation Association for the period December 9th, 1975 to October 31st, 1976. A statement was read from the auditor, Dr. D. Patching, Alberta Environment Conservation Authority, that he had reviewed the transactions and found them acceptable. The motion to adopt the report was seconded by Seraphim. The adoption was carried.

Motion - that the CLRA open a premium savings account and transfer funds from time to time as required, with the signing authority being the same as for the current chequing account (Peters/Bielby). Carried.

On question from Sheard, it was stated that future financial statements would be based on the fiscal year of the CLRA, i.e. September 1st - August 31st.

Correspondence Received

The Secretary pointed out that considerable correspondence had taken place over the past year, particularly between members of the Executive. The outcome of that correspondence was incorporated in the committee reports to be presented later.

Letters of interest and best wishes were read from the Organizing Chairman, 1st British Land Reclamation Conference and the Chairman, Council for Surface Mining and Reclamation Research in Appalachia.

Publications Committee Report

J. V. Thirgood gave a verbal summary of circulated reports.

Motion - that the report of the Publications Committee be adopted, taking into account suggestions from the floor that the new journal must be of high quality, have a low advertising level, that membership of the editorial board should revolve and that papers be published from world-wide sources. (Thirgood/Murray). Carried.

The question of what is the official language(s) of the new journal was raised from the floor. After a brief discussion the President stated that English and French will be the official languages of the new journal and abstracts of papers published will appear in English and French.

Membership Report

P. Lulman gave the membership report showing the number of members in the various categories: Active - 141; Associate - 25; Student - 5; Sustaining - 5; Honorary - 4; Total - 180. (N.B. - honorary members were financial contributors to the Reclamation Newsletter compiled by J. Thirgood, and who had been granted a one-year membership in lieu of their contribution).

Motion - that the report of the Membership Chairman be adopted. (Lulman/Toplack). Carried.

Motion - that memberships during 1975/76 are valid and extended through 1976/77, and new membership fees will become due on September 1st, 1977 (Lulman/Bielby). Carried.

Motion - that sustaining memberships be available in the CLRA for a minimum fee of $100.00 (Lulman/Sheard). Carried.

Ways and Means Report

B. Brooks read his circulated report which included recommendation for a campaign to increase sustaining membership as a major source of income, and that support be solicited from private companies for support of future smoker and banquet events. The report was adopted on motion by Brooks/ Seraphim.

Publicity Report

A written report for T. Laidlaw was read in his absence by E. Watkin. Laidlaw proposed that the low-key drive for active and associate members conducted in 1975/76 should be replaced. With the publication of a new journal an intense effort should be made to obtain a large-scale increase in funding from sustaining memberships, advertising revenues, library subscriptions and direct grants from government or industry. This should be achieved by compiling an information package for distribution to the above.

The question of person or persons to initiate and drive the campaign was raised from the floor, as was the suggestion that the membership form be redesigned to provide a more glossy and attractive document.

Motion - that the report of the Publicity Chairman be accepted in principle (Watkin/Abbott). Carried.

New Business

The Secretary read an invitation from T. Laidlaw that the 2nd Annual Meeting of the Canadian Land Reclamation Association be held in Edmonton, Alberta during 1977. The invitation was issued on behalf of land reclamationists in Alberta.

Motion - that the 2nd Annual Meeting of the CLRA be held in 1977 in Alberta at a location to be determined by CLRA members in that province (Sheard/Schumacher). Carried.

Motion - that the 2nd Annual Meeting of the CLRA be held the week after Labour Day (September 11 - 17, 1977) Peter/Bielby). CARRIED.

The meeting received an invitation from T. Peters to hold the 3rd Annual Meeting of the CLRA in 1978 in Sudbury, Ontario.

Motion - that the 3rd Annual Meeting of the CLRA be held in Sudbury, Ontario in 1978 (Peters/Michelutti). Carried.

The President called for any other business from the floor. Several comments were received suggesting that guidelines and/or standards be laid down regarding data presentation on slides or overheads, that pre-prints or abstracts be available prior to, or at the meeting, of printed papers. The President said that these comments would be passed to the local arrangements committee for consideration.

Nominations

The chair was vacated by J. E. Winch. T. Peters took the chair and read the report of the Nominating Chairman (D. Bayles. This report recommended that after canvassing the members of the CLRA that no change be made in the membership of the interim officers and executive members appointed at the inaugural meeting held in December, 1975. However, the resignation of one Executive member and the declared ineligibility of two members for non-payment of membership dues created three vacancies on the Executive. The Executive Committee recommended that the following members of the CLRA be nominated for the Executive Committee - B. Brooks, R. Berdusco and D. Abbott.

Mr. Peters read the list of nominations to the meeting.

President.....J.E. Winch, Ontario
Vice-President.....J.V. Thirgood, British Columbia
Secretary/Treasurer.....E.M. Watkin, Ontario

Executive Members.....D. Abbott, New Brunswick
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Mr. T. Peters called for further nominations from the floor, None were received and the above list of nominees was accepted as the Executive of the Canadian Land Reclamation Association for 1976-1977.

Mr. Peters vacated the chair, whcih was resumed by J. E. Winch, who then declared the meeting closed.

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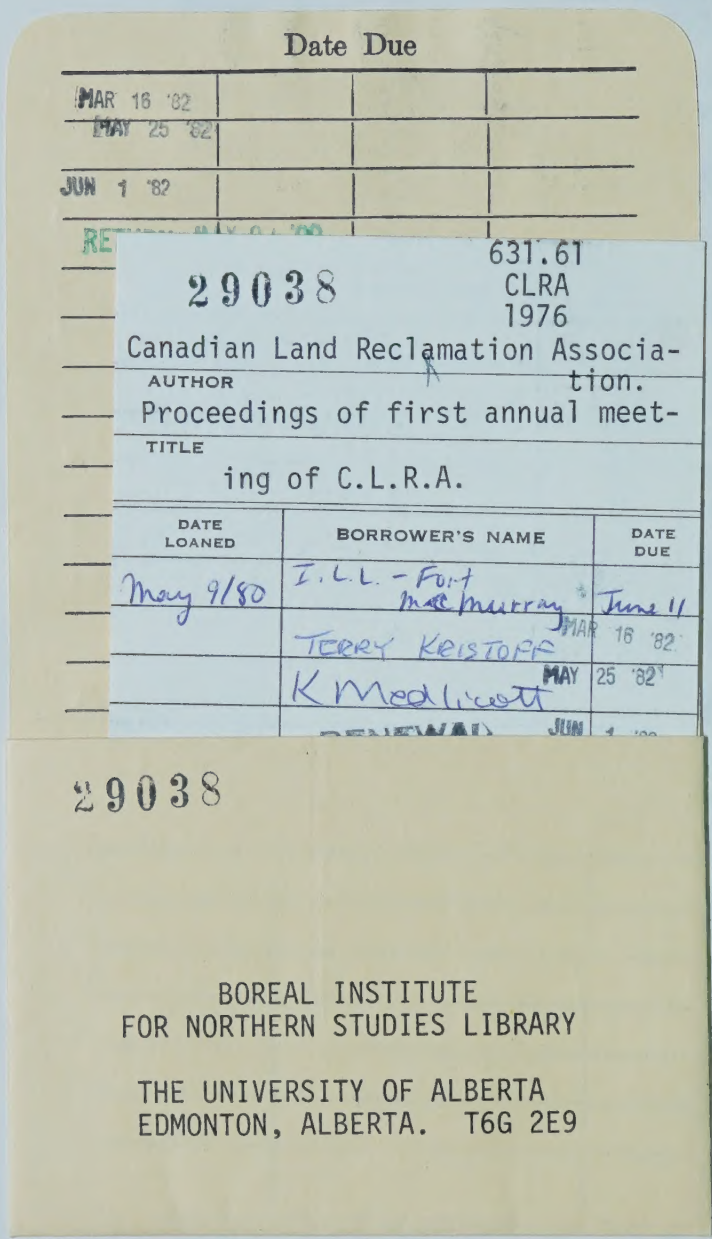

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